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BULLETIN No. 3

1912

The Institute of Industrial Research

of Washington, D. C.

Established December 1, 1910

Scope and Organization

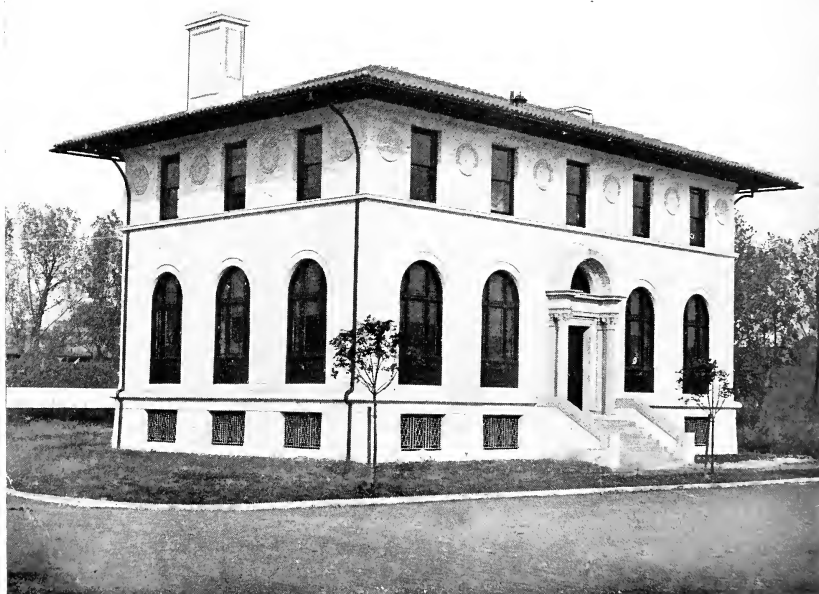


WASHINGTON, D. C.

JANUARY, 1912

Monograph





THE INSTITUTE OF INDUSTRIAL RESEARCH
CORNER 19TH AND B STREETS N. W., WASHINGTON, D. C.

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PRESENT ORGANIZATION OF THE INSTITUTE

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HENRY A. GARDNER, Assistant Director

N. MONROE HOPKINS, M.S., Ph.D., Electrical Engineer

CHAS.A.CRAMPTON, M.D., Ph.C., Food and Drug Expert

GEORGE W. COGGESHALL, Ph.D., Chemical Engineer

PRÉVOST HUBBARD, Chemical Engineer

H. C. FULLER, B.S., Chief Analyst

M. A. DEVINY, B.S., Physicist

F. E. WALKER, B.S., Cement Chemist

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PLAN AND SCOPE OF THE INSTITUTE

THE INSTITUTE OF INDUSTRIAL RESEARCH was founded by Allerton S. Cushman, Henry A. Gardner and N. Monroe Hopkins, December 1, 1910, as a company duly incorporated under the laws of the District of Columbia. The articles of incorporation declare that the objects of the corporation shall be:

"1. To investigate and improve processes of manufacture and to cooperate with manufacturers in the reduction of costs and the utilization of by-products and waste.

"2. To investigate and improve general metallurgical, mining and agricultural operations, so as to improve their efficiency and to disseminate information in regard to such improvements.

"3. To study the problems of paint technology, electrical engineering, and electrochemistry; and to institute economies and improvements in the manufacture of fertilizers and general chemicals.

"4. To train and instruct graduates of scientific and technical schools and other qualified persons in industrial research, and to aid them in obtaining work for which they are particularly fitted; and in general to do and perform every lawful act and thing necessary or expedient to be done or performed for the efficient and profitable conducting of said business, as authorized by the Laws of Congress, and to have and exercise all powers conferred by the laws of the District of Columbia upon said corporation."

The articles of incorporation were purposely drawn so as to provide for the expansion and development of the Institute's work on the broadest possible lines. The branches of the work which have been given the most attention include metallurgical problems, with especial reference to the protection and conservation of the industrial metals; agricultural chemistry, land and fertilizer problems; paint technology in all its branches; food and drug problems with especial reference to the interpretation and compliance with Federal and State legislation; chemical

industry, including the improvement and extension of present processes and the development of new ones; road building and paving problems with especial reference to specifications, inspections, advice and investigations in co-operation with municipalities and other corporations or individuals who desire to retain expert assistance, with chemical and mechanical testing and examination. Electrochemistry and electrical and chemical engineering in general is also made a strong specialty. Patents and their development have proved to offer a field in which the services of the Institute have been useful. Although the Institute does not undertake to do the work of patent solicitors or attorneys, its location in the City of Washington and its broad equipment for investigation enables patent attorneys and inventors to avail themselves of special facilities for working out their problems.

The organization of the Institute is built up on the same plan as some of the scientific bureaus of the Federal Government, in which most of the Divisional Chiefs received their training through many years of official service. The Institute, however, is quite independent of the Government, and is supported entirely by fees and retainers received from clients for service rendered. Ordinary commercial analytical work and testing is carried on to a limited extent, although it is not a principal object of the Institute unless the results sought have a direct bearing on important development problems.

Although research must be essentially scientific and carried on along scientific lines, the intention is to interpret all results obtained in a practical way, so that they will be useful to manufacturers and others who avail themselves of the advantages that the work of the Institute offers.

Many of the great industrial associations of the United States have been within the last few years carrying on research work as a business asset. It is naturally more economical for such associations to avail themselves of an organization and equipment already complete than to establish and endow their own laboratories. Already several of the most important representative organizations

have completed arrangements with the Institute to carry on research work in their respective lines, and the results obtained have fully justified this cooperation.

The laboratories and offices of the Institute are admirably housed in a new and specially designed building which is located on a beautiful site facing on Potomac Park at 19th and B Streets Northwest. It is very near the Bureau of American Republics and about five minutes walk from the White House. The description of the various laboratories and their equipment will be found under the chapter describing the separate divisions of the work.

REPORTS AND PUBLICATIONS

THE INSTITUTE issues from time to time printed bulletins, circulars and reports containing the results of investigation or covering some special field of information. In addition to the printed matter, typewritten reports are furnished to clients on special investigations. Following the practice of the best laboratories, such reports are ordinarily submitted with the understanding that they are not to be used for advertising purposes except in cases in which special arrangement to this end has been made and in which due regard to dignity and ethical principles has been taken into consideration.

The building contains a large lecture hall, which also serves the purpose of a library and demonstration room. It is equipped with lantern Balopticon and projector. This room is available without charge as a meeting place for technical committees of various learned societies meeting in Washington.



LIBRARY, LECTURE, AND DEMONSTRATION HALL

DIVISION OF METALLURGY

ALLERTON S. CUSHMAN, A. M., PH.D., in Charge of Division

THE DIVISION OF METALLURGY is prepared to undertake work in all problems in the line of metallurgy, including the mining, chemistry and evaluation of fuels and industrial minerals. Special attention and study have been given to corrosion problems and methods of overcoming these difficulties. Although not strictly speaking a metallurgical problem, examinations and reports on water supplies are handled in this Division. This work is taken up in both the sanitary and industrial phases of the subject, and includes sewage and drainage problems. In many cases the rapid corrosion of boilers and metallic containers is principally due to the character of the water supply, which may easily be modified by proper treatment. Refrigeration engineering and boiler practice introduce a number of problems which only the trained chemical engineer, with a full laboratory equipment at his service, can hope to solve. The conservation of metals and minerals of all kinds, the utilization of by-products and saving of wastes are among the subjects of great importance, on which the advice and work of this Division is frequently called for.

The Division of Metallurgy is under the direction of Dr. Allerton S. Cushman, assisted by the general staff of the Institute. Dr. Cushman took his Bachelor's degree in chemistry at the Worcester Polytechnic Institute, under Professor Leonard Kinnicutt, in 1888. He then went to Germany and studied metallurgy under Professors Richter and Ledebur, at the Royal School of Mines in Freiberg, Saxony. He also studied for a time in the laboratory under the celebrated Professor Bunsen, at Heidelberg University, Bavaria. After some years' professional practice and teaching in the West, he went to Harvard University, where he took his Master's and Doctor's degrees, under Professors Jackson, Hill and Theodore Richards. For three years Dr. Cushman worked under Dr. H. W. Wiley in the United States Bureau of Chemistry, and was then

made Assistant Director of the United States Office of Public Roads in Charge of Chemical and Physical Investigations, which position he held for six years until November, 1910.

DIVISION OF PAINT TECHNOLOGY

HENRY A. GARDNER, in Charge of Division

THE DIVISION OF PAINT TECHNOLOGY is under the direction of Mr. Henry A. Gardner, Assistant Director of the Institute, who is well known as a writer and authority on paint problems. Mr. Gardner has acted as Director of the Scientific Section of the Paint Manufacturers' Association of the U. S., and has been for many years in charge of the laboratory experimental work that has been carried on by this Association. This work, which now forms one of the chief activities of this Division, is



CORNER OF PAINT TESTING LABORATORY

being continued under Mr. Gardner's supervision in the specially designed and thoroughly equipped paint laboratories of the Institute, where every facility is afforded for its prosecution in a thoroughly practical as well as scientific manner.

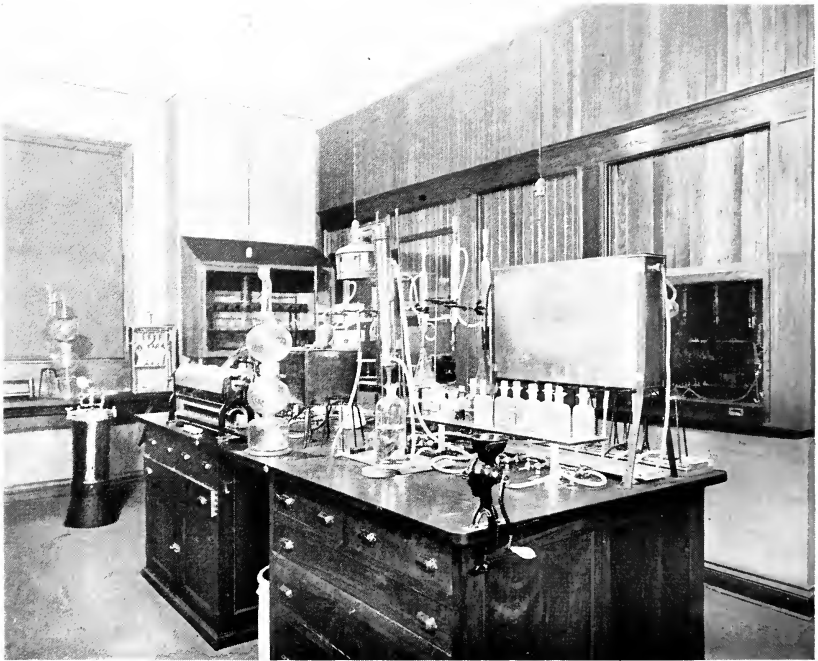
The extensive exposure tests in different sections of this country, which were designed to determine the comparative merits of protective coatings and paint products for various

structural materials, are being continued and inspected from time to time in order that reports and bulletins may be issued and information distributed. Additional systematic exposure tests have recently been undertaken by this Division on the Institute grounds at Washington, in conjunction with important laboratory researches to determine the physical and chemical properties of oils and oil mixtures.

This Division does not undertake the examination or commercial analysis of proprietary brands of paint or varnishes, with the object of furnishing reports or certificates regarding their comparative value or relative durability. The Division is, however, in a position to carry on research work to determine the usefulness of various products as paint constituents. Various materials which appear not to be suited for certain specific uses, and regarding which there is little information on record, are often found upon investigation to be subject to treatment that renders them satisfactory, or they may be found to possess characteristics which make them of great value in certain lines of manufacture. Study of such products, with a view to working out methods for their utilization, will be undertaken.

Advice to engineers, architects or painters regarding the better types of protective coatings for the exterior or interior of buildings is given out from time to time without charge, in bulletin form. The regular serial bulletins of the Scientific Section of the Paint Manufacturers' Association are still being carried on.

Consultation upon special problems which demand investigation work will be undertaken for clients at charges commensurate with the service. The study of oils, oil substitutes, thinners, primers, driers, and waterproofing compounds represents an important branch of the work of this Division, in which its services are available. This Division cooperates with the other Divisions in working out the best treatment for protecting various materials of construction, among which may be instanced protective coatings for the industrial metals, particularly iron and steel, and cement mortar and concrete structures.



VIEW OF ONE OF THE CHEMICAL LABORATORIES

DIVISION OF FOODS, DRUGS, AND AGRICULTURAL CHEMISTRY

CHARLES A. CRAMPTON, M. D., PH.C., in Charge of Division

THIS DIVISION handles all problems relating to the manufacture and marketing of food and drug products. Within the past few years much legislation has been enacted regulating the production and sale of materials and preparations intended for use as food or medicine. The Food and Drugs Act and the Meat Inspection Act under the control of the United States Department of Agriculture, the Oleomargarine Law, the tariff acts relating to tea, and the inspection of antitoxine manufactories under the Treasury Department, may be cited as instances of Federal laws of this character, and most of the States have enacted laws governing either dairy products or food products in general. These laws, together with the general quickening of the interest of the consuming public in the character of the food and medicine with which it is supplied, have had a most important effect upon the manufacturers and dealers in such products. Processes of manufacture, methods of storage, shipment and handling, containers, labels, advertising matter, in fact everything pertaining to the many industries engaged in this extensive commerce, have undergone a tremendous revolution within the past few years, and the end is not yet in sight. Proposed legislation is now before committees of Congress which, if enacted into law, would very greatly extend existent governmental control over commerce in food products. Impending tariff legislation is also a subject of grave concern to many lines of manufacture.

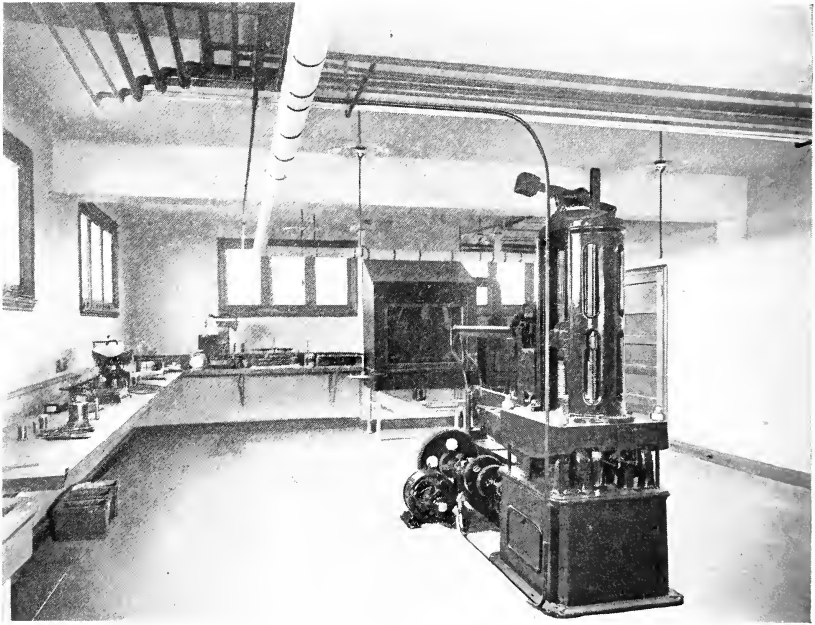
This Division of the Institute is admirably equipped for dealing with all matters arising under present or proposed laws controlling or regulating the manufacture and sale or the importation for sale of food and drug products. It will undertake cases for clients before the Board of Food and Drug Inspection, the various Departments of the Government charged with the execution of such laws, and the

Federal Courts. It will represent individual clients or groups of manufacturers before Committees of Congress, concerning impending legislation, and it will give advice to manufacturers and dealers in regard to meeting the requirements of food control by changes and improvements in methods of manufacture, handling, labeling and marketing. In addition to matters arising under the various laws, the Institute solicits correspondence in regard to all possible investigations connected with the food and drug industries in the direction of improvements, economies, utilization of waste materials, development of new products, etc. Problems common to entire lines of industries are particularly desired. An example is furnished by the work at present being carried on by the Institute for the National Canners' Association. An experimental food pack comprising a great many thousand cans of different kinds of food products has been put up under test conditions, both as to the manufacture of the containers and the packing and processing of the foods. The object is to study the action of the container on the food, as well as that of the food on the container, and thus bring about practical improvements in two great industries. Two of the great Government Departments, War and Agriculture, are interested in this work, and are cooperating in it as far as is possible and proper. Toxicological work is also done in this Division, and steps are being taken to include a subdivision of bacteriology and fermentology.

The efficiency of the Division in dealing with matters of Government control of food and drug products is greatly enhanced by the long experience of the men in charge of this work, in the branches of the Government which deal with the laws pertaining to such regulation.

The Chief of the Division, Dr. Charles A. Crampton, served twenty years as Chief Chemist of the Internal Revenue Bureau of the Treasury Department, and prior to that time several years as Dr. Wiley's principal assistant in the Bureau of Chemistry of the Department of Agriculture. While in the Department of Agriculture he participated in the investigations (see Bulletin No. 13) which furnished

the foundations for the present Pure Food and Drug Act, and in the Treasury Department he had charge of the technical administration of the laws taxing various food and drug products, such as oleomargarine, renovated and adulterated butter, fermented and distilled liquors, sugar, etc. He is also thoroughly familiar with customs matters, having served on numerous commissions for fixing drawback rates, etc., which equips him for expert work before Customs Courts and the Tariff Commission. He is especially expert in his knowledge of the operation of the denatured alcohol law, having had charge of its administration since its inception, and having made two trips to Europe for the Government in connection with its enforcement. In addition to his knowledge of the various laws, Dr. Crampton is thoroughly qualified to take charge of all possible investigations connected with the food and drug industries, and his services are available for general work involving organic analysis of the highest character. The Assistant Chief of the Division, Mr. H. C. Fuller, was employed in the Bureau of Chemistry about five years before becoming connected with the Institute, during which time he testified as an expert witness for the Government in many cases of prosecution under the Food and Drugs Act. Prior to his connection with the Bureau of Chemistry he was in the employ successively of the large drug manufacturing concerns, Mallinckrodt Chemical Works and Parke, Davis & Company, for a period of four years. He has, therefore, had experience both in practical commercial work and in Government control work, giving him a breadth of training which has fitted him most thoroughly for the work of the Institute.



CEMENT AND TESTING LABORATORY

DIVISION OF ROADS AND PAVEMENTS AND MATERIALS OF CONSTRUCTION

PRÉVOST HUBBARD, in Charge of Division

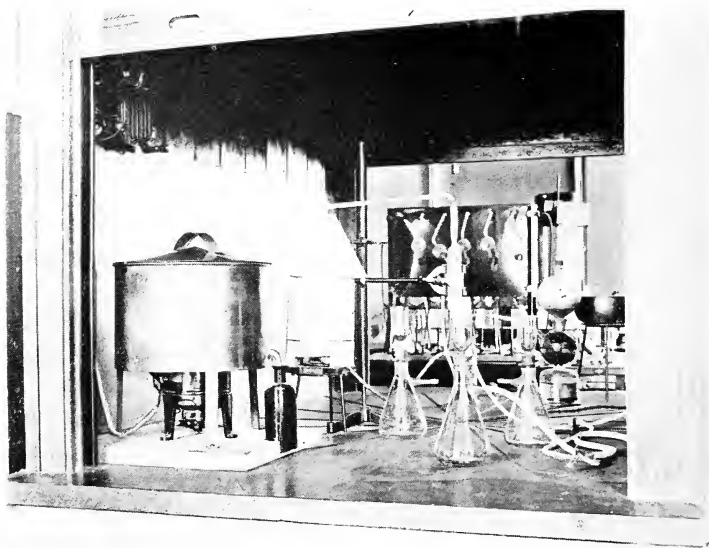
TWO WELL-EQUIPPED laboratories have been given over to this Division, the "Cement and Testing Laboratory" and the "Bitumen Laboratory."

The "Cement and Testing Laboratory" is located in the basement and is a large, well-lighted room with cement concrete floor, measuring 700 sq. ft. It is equipped with the usual laboratory benches and hood, and contains a 150,000-pound motor-driven Riehle Testing Machine, a Fairbanks Cement Testing Machine of the latest improved construction, a moist closet, steam chamber, storage tanks and muffle-furnace, together with a complete cement testing outfit. This laboratory is devoted to the physical testing of cements, rocks, clays, brick, block, iron, steel, wood, rubber and other materials of construction.

The "Bitumen Laboratory" is located in the southeast corner of the second floor, and is twelve by twenty-four feet. It contains an alberene stone top laboratory table, alberene stone working shelves along the walls, two large alberene stone hoods, one for general use and the other for distillation and extraction work with inflammable solvents. All of the working space is piped for gas, water, blast and vacuum, and is wired for electrical connections. The equipment is thoroughly complete and up-to-date. Among other things may be mentioned the following apparatus: A penetration machine, float test apparatus, a motor-driven ductility machine, a motor-driven extractor for bituminous aggregates, an Office of Public Roads melting point apparatus, viscosimeter, flash and fire testers, a cold chamber, an oven for volatilization tests equipped with a gas regulator, hot plates, a sulphur determination apparatus, and hot and cold extraction apparatus. In addition, it is well equipped with glass, porcelain, platinum and iron ware, and reagents for the usual chemical work.

In this laboratory petroleum and petroleum products, tars and tar products, creosoting oils, asphalts, bituminous emulsions, bituminous aggregates and all other types of chemical road and paving materials, roofing materials, rubber, etc., are examined and tested. Chemical examinations of rocks, clays, cement, etc., are also made here, and researches conducted on improvements in industrial products and processes and the utilization of waste products for road purposes.

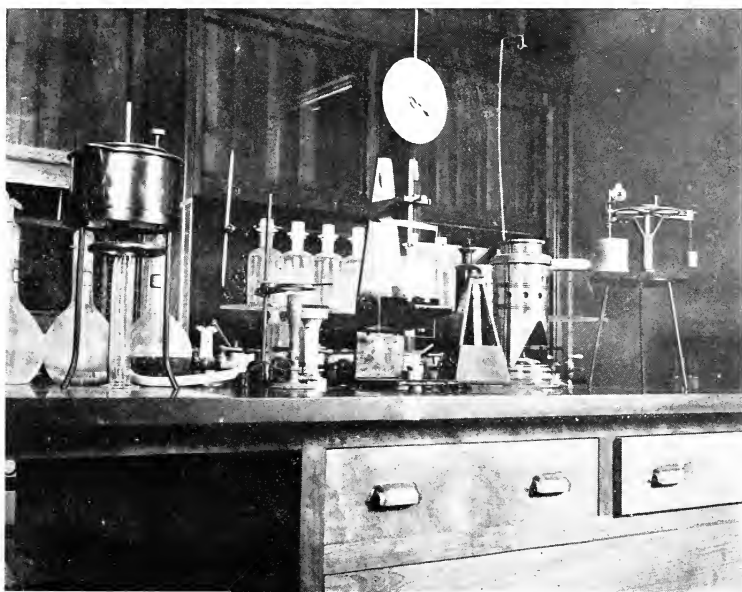
This Division of the Institute is under the supervision



EXTRACTION HOOD—BITUMEN LABORATORY

of Mr. Prévost Hubbard, who was formerly Chief Chemist of the Office of Public Roads, United States Department of Agriculture. Mr. Hubbard is the author of "Dust Preventives and Road Binders" and of many other publications on similar subjects. He has had wide experience in the examination and use of all types of road and paving materials, and has been engaged as lecturer on engineering chemistry in the new post-graduate course in highway engineering at Columbia University.

Although the Division was the last one organized, a considerable amount of work has already been accomplished. Important investigations have been conducted for the Association of American Portland Cement Manufacturers, the results of which will become available to the public from time to time. Among the problems now being studied are methods of preventing damage to Portland cement concrete by salt and alkaline water, the effect of temperature and humidity upon the setting of cements, methods of water-proofing concrete, and methods of preventing dam-



CORNER OF BITUMEN LABORATORY

age by electrolysis in concrete structures reinforced with iron or steel. The utilization of concrete tanks for storing various commercial liquors, and solutions used in industrial processes is also being investigated. A large number of concrete test pans have been constructed for this purpose, and a concrete test house for their storage. Test pans composed of Portland cement concrete prepared and treated in various ways, have been filled with various commercial liquors, both cold and hot, and the effect on both

concrete and liquor is being carefully studied. This work has been started owing to numerous requests for information on the part of manufacturers who desire to use concrete tanks for storage purposes, and it is believed that the results will open up a new and important field for the utilization of cement.

This Division is also engaged in an important investigation of the relative value of different types of road and paving materials under various local conditions, and the inspection and supervision of roads and pavements of all types and their materials of construction. It is prepared to furnish specifications and advice regarding road and paving problems, and also improvements of materials and processes relating to the road and paving material industries. The Division also engages in the preparation of expert evidence to be used in litigation when the purposes of clients are thoroughly straightforward and honest.

The Institute invites to this Division the attention of all public services bodies, associations, corporations and individuals who are interested in the manufacture and use of cements, concretes, road and paving materials and all other materials of construction. The interests of all clients of the Institute are carefully and loyally guarded in every way.



A CORNER OF THE PHYSICAL AND ELECTRICAL ENGINEERING LABORATORY

DIVISION OF ELECTRICAL ENGINEERING, PHYSICS, AND ELECTROCHEMISTRY

NEVIL MONROE HOPKINS, M. S., PH.D., in Charge of Division

THIS DIVISION of the Institute is prepared to undertake experimental work in the field of applied electricity, physics and electrochemistry; to assist inventors in developing their ideas, machines or processes; to furnish scientific data to the Patent Office for such clients in cases of complicated applications, and to give expert testimony in patent litigation. The design of scientific instruments is made a specialty, as well as tests of motors, generators, transformers, lamps, primary and storage batteries, lightning arresters, protective devices, fuses, circuit breakers, high and low tension magnetos, etc., etc. Certificates of tests will be furnished by the Institute when this is justified by the circumstances and the performance of the device warrants it. Special attention will also be given to all classes of electric automatic devices, and materials used in the various electrical arts and manufactures. In the field of heavy electrical engineering, the Institute is prepared to supply complete designs of central stations for light and power, as well as designs for isolated plants for towns and country residences. The preparation of specifications and the purchase for clients of materials in the foreign or domestic market is made a specialty. The laboratories of the Institute are equipped with standard instruments of precision for various kinds of electrical currents, direct and alternating, single and polyphase, of all commercial voltages and frequencies. Provision is also made for high voltages for the testing of insulation, and insulating compounds at commercial frequencies, as well as for very high voltages at high frequencies. Direct current of heavy amperage is available for welding, electrical furnace work, for making permanent magnets and for metallurgical and electrochemical processes. The experimental department includes every type of electrical measuring instrument;

such as ammeters, voltmeters, wattmeters, dynamometers, for both alternating and direct current, alternating and direct current comparators, oscillographs for wave form determinations of electro-motive force, current and power. Standards of resistance, inductance and capacity of the most approved pattern, also form a part of the equipment. Facilities for the testing of the magnetic properties of iron and steel are provided for, as well as constant and variable temperature space for studying the electrical properties of alloys. The equipment includes facilities for work in the field of wireless telegraphy and telephony, Roentgen rays, very high electrical pressures at high frequencies, and for experiments in electrical discharges through gases. Investigations and experiments at high and low temperatures can also be undertaken.

The Division is under the immediate charge of Dr. Nevil Monroe Hopkins, who has had special training and practical experience in the field of electrical engineering, applied physics, electrochemistry, and general experimental work. Dr. Hopkins first studied the physical sciences during eight years spent in Germany and France. After this, he worked through the shops and various departments of the General Electric Company, at Schenectady, New York. After a number of years in machine shop and practical testing work, Dr. Hopkins took up university studies, specializing in physics, chemistry and electrical engineering at the Corcoran Scientific School and at Columbian and Harvard Universities, taking successively the degrees of Bachelor of Science, Master of Science, and Doctor of Philosophy. Dr. Hopkins has been associated for many years with Professor Charles E. Munroe as an assistant, later as Instructor and Assistant Professor in the School of Graduate Studies of The George Washington University. Dr. Hopkins has worked successfully upon a large number of electrical and physical problems for many large corporations, municipalities and individuals, and has been instrumental in the perfecting of a number of noteworthy electrical inventions. He was appointed Electrical Engineer in the U. S. Navy

Department by Ex-President Roosevelt, on account of the Consolidation of Power Plants at all Navy Yards and Naval Stations, and had to do with the entire field of electricity ashore in the Navy, in designing central power stations, lighting systems, the driving of heavy and light machine tools by electric motors and the writing of standard specifications for all classes of electrical apparatus. Dr. Hopkins was appointed Mechanical Expert in the U. S. Office of Public Roads subsequent to the completion of the Navy work. He is the author of numerous scientific articles and books.

DIVISION OF MILL PROBLEMS

GEORGE W. COGGESHALL, PH.D., in Charge of Division

INDUSTRIAL RESEARCH demands the fullest cooperation between the producer or manufacturer and the investigation laboratory. It frequently becomes necessary to adapt laboratory results to the mill scale of operation, and in addition to this many problems are best studied in the actual field of manufacturing operation. The Division of Mill Problems has been organized to deal particularly with this phase of the work. The Division is under the supervision of Dr. George W. Coggeshall, who is especially fitted by education and training to direct this work. Dr. Coggeshall received his bachelor's degree at Grinnell, in 1890; he then went to Germany and took his doctorate under the celebrated Professor Ostwald, at Leipzig. He was for several years instructor in Physical Chemistry at Harvard University, and for the last ten years has been engaged in manufacturing and applied chemistry. A specialty is made of designs and estimates for modernizing old industrial plants and the construction of new ones. The adaptation of patented processes and products to the commercial scale of operation is a branch of the work which it is believed will be found useful by inventors and capitalists who are attempting to develop new lines of industry or improve old ones. Dr. Coggeshall's special training, taken in conjunction with the broad field covered by the various Divisions of the Institute, is a guarantee of efficient service along these special lines.

This Division has been engaged on a number of problems of a highly important nature, some of which have been successfully solved, while others promise to develop interesting results. It is believed that the coordination of theory with practice, that is made possible by this Division, will be appreciated by producers and manufacturers who wish to broaden or reduce the costs of their production by availing themselves of the latest and best scientific methods.





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